PERSONAL COMPUTER VIDEO DISPLAYS AND INPUT DEVICES

INTRODUCTION

The video display is one of the versatile pieces of equipment in a computer system. When used in a large system, it displays the status of computer operations and displays the results of maintenance programs. When used with a personal computer, the video monitor is the primary output device the computer uses to communicate with the user.

In addition to having a video monitor as an output device, most computers also have at least one input device, such as a keyboard. The input devices enables the user to control the computer.

After completing this chapter, you should be able to:

• **Describe the operation of video display monitors used with personal computer systems**

• **Describe the operation of MDA, CGA, EGA, VGA, SVGA, and XGA graphics adapters used to drive video monitors**

• **Describe the operation of flat screen displays using liquid crystal display technology**

• **Describe the operation of various input devices used with video display terminals**

VIDEO DISPLAY MONITORS AND ADAPTERS

The video display monitor is the primary output device that interfaces the user to the computer. In this section, we cover the different types of video displays used with personal computers.

Video displays have two main components: the video monitor and a video adapter. The video adapter is plugged into the PC's motherboard.

VIDEO DISPLAY MONITORS

Video display monitors come in a variety of shapes, sizes, and capabilities. They can be color or monochrome, use interlaced or noninterlaced scan, and require either analog or digital (cathode-ray tube [CRT]) drive signals.

Composite video monitors are the simplest type of monitor. The video signal is combined on a single line with the horizontal and vertical timing signals before being sent to the monitor. The monitor electronics separate the video signals and the

horizontal and vertical timing signals. Composite monitors can be either monochrome or color.

RGB (red, green, blue) monitors are color monitors that use a separate input for each color. They have greater resolution than the composite video monitors.

EGA (Enhanced Graphics Adapter) and **VGA** (Video Graphics Array) monitors are RGB monitors that have even greater resolution. Both EGA and VGA monitors display sharper characters and graphics than does the RGB monitor. EGA monitors can display 43 lines of text instead of the standard 25 lines of the RGB monitor. VGA monitors can display up to 50 lines of text.

VGA monitors are designed to use analog signals rather than digital signals to drive the CRT guns. Digital signals limit the maximum number of colors that can be displayed to 16. By using variable (analog) signals to drive the CRT guns, current video adaptersand monitors are capable of displaying over 256,000 colors. The super VGA and XGA monitors also use analog signals. If you are upgrading your monitor, be sure that the display adapter is compatible with the new monitor.

Also, there are multiscan or multisync monitors that can be used with a variety of video cards. These monitors detect the rate that data is being received and adjust their scan rates to match the input.

As you can see, the type of monitor you have must be compatible with the type of video card in the computer. You can literally burn up a monitor by plugging it into the wrong type of video card.

Video monitors require very little preventive maintenance. They should be cleaned periodically to remove any dust that has collected on the components. Repair of a failed monitor is difficult because the monitor diagrams are hard to obtain from the manufacturer. Also, the price of the repair parts often exceeds the cost of a new monitor.

VIDEO DISPLAY ADAPTERS

The video display adapter is a circuit card that plugs into the personal computer to drive the monitor. Video adapter cards play a major role in how many colors are displayed and the speed with which the display is updated. Common video adapters are:

- MDA (Monochrome Display Adapter)
- CGA (Color Graphics Adapter)
- EGA (Enhanced Graphics Adapter)
- VGA (Video Graphics Array)
- SVGA (Super Video Graphics Array)
- XGA (Extended Graphics Array)

Monochrome Display Adapter (MDA)

The monochrome display adapter (MDA) was the first display adapter available. It is designed to work with a monochrome **transistor-transistor logic** (TTL) monitor. It is a text-only system that cannot display graphics or color. The MDA uses a 9 x 14 dot character box that provides clean sharp characters. Because most of the software packages developed today, even word processing and spreadsheets, use graphics to some extent, the MDA is generally considered obsolete.

Color Graphics Adapter (CGA)

The color graphics adapter (CGA) was, at one time, the most common graphics adapter available. It supports an RGB monitor with a maximum resolution of 640 x 200 pixels. The CGA card has two modes of operation: alphanumeric (A/N) and all points addressable (APA). In both modes, the basic character set is formed with a resolution of 8 x 8 pixels. The CGA card displays either 40 or 80 columns with 25 lines of text. In the A/N mode, the CGA card can display up to 16 colors.

The all points addressable mode of operation can address each pixel individually. The CGA APA mode supports two resolutions on the screen: medium and high. The medium resolution is capable of addressing 320 x 200 pixels with 4 colors. The high resolution is

capable of a 640 x 200 display using 2 colors. Because of these limitations, the CGA adapter is generally considered obsolete.

Enhanced Graphics Adapter (EGA)

The enhanced graphics adapter (EGA) superseded the CGA adapter and drives an RGB monitor. The EGA provides 16 colors at a resolution of 320 x 200 or 640 x 200. The character box for text is 8 x 14 instead of the 8 x 8 used with the CGA card.

The EGA card comes with 64K of video memory that is expandable to 256K using a graphics memory expansion card. This card adds an additional 64K of video memory. The EGA card also uses 128K of RAM from the computer's RAM. The video is stored just above the 640K boundary. Video memory is used to refresh the display, freeing up the CPU chip for other operations.

Video Graphics Array (VGA)

The video graphics array (VGA) adapter card overcame the limitations earlier adapters had in displaying high quality color. The earlier adapters used digital signals to control the three electron guns of the CRT. Each gun was either turned on or off by these signals and limited the display to 8 colors. By adding a high and a low intensity signal, the number of colors that could be displayed was doubled to 16.

The VGA card generates analog signals to control the electron guns and, therefore, can control the intensity of each gun at varying levels. Current VGA cards are capable of displaying 256 colors and generating 262,144 (256K) colors. Since the VGA generates analog signals, be sure the monitor is capable of accepting these signals.

The VGA card displays text in a 9 x 16 character box and has a resolution of 640 x 480.

Super Video Graphics Adapter (SVGA)

Super video graphics array (SVGA) is a term used to describe graphic adapters that have exceeded those of the VGA system. As of now, there is no set standard for SVGA. Resolutions for SVGA vary by manufacturer but 800 x 600 and 1024 x 780 are common. Some SVGA cards work on a 60-Hz vertical scan rate and some use 70 Hz. Once an SVGA card is installed, a software driver that describes the specifications of that card needs to be installed.

Extended Graphics Array (XGA)

The extended graphics array (XGA) is a refinement of the VGA standard. The XGA system provides a 32-bit bus master for micro channel-based systems. The bus master has its own processor that allows it to operate independently of the motherboard, freeing the main processor.

The XGA system also provides greater resolution and more colors than the VGA system. The XGA can hold up to 1M of video memory. Resolution is variable, depending on the mode selected. Maximum resolution is 1024 x 768, with the capability of displaying 256 colors from a palette of 262,144 colors. The XGA can also display 65,536 colors at a resolution of 640 x 480, providing almost photographic quality color.

Video Adapter Maintenance

As with the monitor, maintenance of video driver cards is generally limited to replacement of the card. Special test equipment is available for component level repair of some video drivers.

LIQUID CRYSTAL DISPLAYS

The development of laptop and notebook computers required a high resolution flat screen display with low power consumption. The most popular are passive and active matrix liquid crystal displays (LCDs).

Liquid crystals have been used for digital calculators and watches for years, but the size required had made them impractical for computer use. Recent improvements in LCD technology reduced the size of the LCD pixel to compare with the size of a CRT pixel.

Liquid crystal displays operate on the principle of scattering the light from an outside source to provide the desired pattern. The display from a liquid crystal is usually gray or black, but color can be achieved through the use of filters or dyes. They require low power and low voltage, making them ideal for laptop and notebook computers.

In manufacturing LCDs, a clear, conductive material is deposited on the inside surfaces of two sheets of glass. This material acts as one electrode. The liquid crystal material is then deposited on the glass in the desired pattern. This pattern can be segmented (watches and calculators), dot matrix (graphic and computer screens), or a custom layout for special purposes. A terminal conductor is connected to an external terminal to control each liquid crystal. The two sheets of glass are then hermetically sealed at the edges.

Passive Matrix Liquid Crystal Displays

Passive matrix liquid crystal displays are used in most monochrome and color laptop computers today. The LCDs are arranged in a dot matrix pattern. Resolution of 640 columns by 480 rows is not uncommon. Characters are formed by addressing each row and column.

Color passive matrix LCDs use three layers of crystals each separated by a color filter. Color is achieved by energizing one, two, or all three LCDs for each pixel.

Passive matrix LCDs have some distinct disadvantages. They have low contrast. This lack of contrast has required the addition of a backlight to aid the user in viewing the screen. The response time to turn the pixels on and off is too slow for full-motion video and can produce a ghosting effect when changing full-screen displays. Color passive matrix LCDs are limited to displaying 16 colors

simultaneously, even though the VGA adapter can have a palette of 262,144 colors.

Active Matrix Liquid Crystal Displays

Active matrix liquid crystal displays closely emulate the capabilities of the full-color CRT. The perfection of the thin film transistor (TFT) is largely responsible for the development of the active matrix LCD. Active matrix LCDs offer a brighter screen, provide response times fast enough to accommodate full-motion video, and can display 256 colors simultaneously.

In manufacturing an active matrix display panel, each pixel consists of three crystals, one each for red, green, and blue. Three TFTs control each pixel, one for each color. The TFT technology allows for entire logic circuits, driver circuits, and even microprocessors to be deposited transparently on the glass plates, increasing the brightness, speed, and color quality of the display.

INPUT DEVICES

The displays discussed in this chapter are output devices. They display information from the computer for the user. To allow the user to act on the information being displayed, some type of input device is required. The most common input device is a keyboard. Increasing in popularity are cursor pointing devices such as the mouse or trackball.

KEYBOARD

The keyboard is the basic input device for personal computers. There are several styles of keyboards available, but the most common one today is the 101-key enhanced keyboard.

Keyboard Layout

The 101-key enhanced keyboard made several improvements over the 84-key keyboard. Two new function keys, F11 and F12, were added. The function keys were moved from the left side of the keyboard to the top of the keyboard. A group of dedicated cursor and screen control keys were added

and the CTRL and ALT keys were duplicated and placed on each side of the space bar.

The 101-key enhanced keyboard has four functional areas:

- Typing area

- Numeric keypad

- Functions keys

- Cursor and screen controls

The typing area is the main section of the keyboard and is setup similar to a standard typewriter keyboard. The CTRL and ALT keys, located on either side of the space bar, allow the programmer to add additional meaning to standard keys. For example, when working with a word processing program, depressing the *CTRL* and *I* keys simultaneously may cause a macro program to run that will turn the *italics* font on or off.

The numeric keypad is located on the right side of the keyboard. It contains the 10 numeric keys (0 - 9), the keys required for addition (+), subtraction (-), multiplication (*) and division (/). An additional ENTER key was added to the numeric keypad to ease operation. Just like the 84-key keyboard, the numeric keypad can also be used for cursor and screen control when not in the NUMLOCK (number lock) mode.

The function keys are located in groups of four across the top of the typing area of the keyboard. The escape (ESC) key is in the top left corner and dedicated PRINTSCRN/SYSREQ, SCROLL LOCK, and PAUSE/BREAK keys are provided for these commonly used functions.

The cursor and screen control keys are located between the typing area and the numeric keypad. The cursor control keys are located on the bottom in an inverted T pattern. Above the cursor control keys are the INSERT, HOME, PAGE UP, DELETE, END, and PAGE DOWN keys.

Keyboard Operation

Two types of switches are used in keyboards. Most keyboards use microswitches for each key position. Depressing a switch sends the position data of that switch to the computer.

The other type of keyboard switch is the capacitive keyboard. The bottom of the keyboard is one large capacitor. Pushing a key switch pushes a paddle into the capacitive module, changing the capacitance of the module. This signal is interpreted by the keyboard microprocessor and sent to the computer.

Keyboard Compatibility

The original IBM PC and XT computers came equipped with an 83-key keyboard. When IBM introduced the AT computer, it came with a new 84-key keyboard. Later, the 101-keyboard was introduced with newer AT computers and has become the industry standard. The 84-key keyboard uses a different keyboard microprocessor than its 83-key predecessor and is not interchangeable. Many third party keyboard manufacturers have overcome this problem by enhancing the keyboard microprocessor and adding a switch on the bottom of the keyboard. This switch, marked AT/AX selects the system with which the keyboard is to be used. The keyboard microprocessor then executes the proper routines. Many 101-key keyboards are also equipped with an AT/XT SELECT switch. A computer that was originally equipped with an 84-key keyboard should accept a 101-key enhanced keyboard. If a 101-key keyboard is installed on a computer that was originally equipped with an 84-key keyboard and the new keys (Fl1, F12, etc.) do not function, then the ROM BIOS needs to be upgraded.

Keyboard Maintenance

Maintenance of keyboards consists of periodically cleaning the keyboard. Turn the keyboard over and gently shake it to dislodge any loose dirt. The keyboard can also be blown out with dry compressed air. If a microswitch-type keyboard has a key that is

sticking, the key can be removed and cleaned or replaced.

MOUSE

The mouse is quickly becoming a very popular input device. Some programs, especially graphic user interface (GUI) programs, virtually require a mouse.

Mice are available in several shapes and sizes, but all operate in about the same way. The mouse case is plastic and designed to fit your hand. On the top of the mouse are two or more buttons. These buttons are used to indicate to the computer that an action is desired at the current location of the pointer. For example, one popular GUI program will activate a program when the cursor pointer is placed over a program icon and the left mouse button is pushed twice.

If you turn the mouse over, you will see a small rubber ball. As you move the mouse across the desk top, this ball rolls and moves the encoders inside the mouse. Remove the access plate and remove this ball and you will see two or three rollers. These are the position encoders that send movement data to the computer.

Mouse Connections

A mouse can be connected to the computer in several ways. These are the mouse port, a serial mouse, and a bus mouse.

The mouse port is the simplest way to interface the mouse with the computer. A special, dedicated port is built into the motherboard of the computer. The mouse is plugged directly into this port.

The serial mouse is plugged into one of the computer's serial ports. When the computer is booted, the mouse driver searches the ports to determine which port the mouse is connected to.

The bus mouse is for users that do not have a free serial port. The mouse is plugged into a special interface board that is installed into one of the computer's expansion slots. The mouse then communicates with the computer across the main bus.

Recently, some manufacturers have introduced the cordless mouse. The cordless mouse requires a special interface card that plugs into one of the expansion slots. The mouse is equipped with a small, low-power radio transmitter that transmits mouse movements to the interface card. The receiver on the interface card decodes the signal and sends it to the mouse driver program.

Mouse Maintenance

A mouse requires very little maintenance. About the only maintenance is to clean the mouse if the pointer movement is erratic or jerky. To clean the mouse, turn off the computer and remove the rubber ball. Clean the ball with a mild detergent and water. Clean the encoder rollers with a lint-free swab and a cleaning solvent such as denatured alcohol. Be sure the ball is completely dry before reinstalling it and applying power to the computer.

TRACKBALL

The trackball, used with personal computers, is another pointer device that can be used instead of the mouse. A trackball is basically a mouse turned over and the ball exposed. The user rolls the ball, moving the pointer on the screen. The trackball operates the same way the mouse does. Many laptop computers are being manufactured with a trackball installed in the keyboard, eliminating the need for an external mouse. Full-size keyboards are also available with a built-in trackball.

SUMMARY-PERSONAL COMPUTER VIDEO DISPLAYS AND INPUT DEVICES

This chapter has presented material about video display monitors, video adapters, and their input devices. The following information summarizes important points you should have learned.

VIDEO DISPLAY MONITORS– Video display monitors come in several sizes and styles. They can be monochrome or color. They can be driven by digital or analog signals. Analog signals are able to present a higher quality picture.

VIDEO DISPLAY ADAPTERS– Video display adapters provide the signals to the monitor to display the picture. Video adapters can generate monochrome or color displays. It is extremely important that the monitor be compatible with the video adapter. A digital monitor connected to an analog adapter could cause serious damage to the monitor and computer.

Several video adapters cannot generate graphic displays. Resolution of the display can be controlled by some video adapters. Many video adapters contain some random access memory (RAM) for refreshing the display.

INPUT DEVICES— Common input devices used with personal computers are the keyboard, mouse, and trackball. The 101-key enhanced keyboard is the most common keyboard and considered the standard keyboard. A mouse is a pointer device that allows the user to quickly move the cursor about the screen. The trackball functions in the same way as the mouse.